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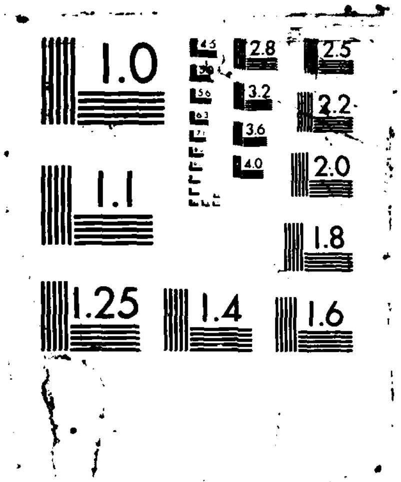
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AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

THE ROLE OF AIR BASE OPERABILITY
IN
TACTICAL MISSILE DEFENSE

MAJOR STEPHEN A. FLEET 88-920

"insights into tomorrow"

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REPORT NUMBER 88-920

TITLE THE ROLE OF AIR BASE OPERABILITY IN TACTICAL MISSILE DEFENSE

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The emergence of a new generation of Soviet short-range, conventional, tactical ballistic missiles (FROG, SS-1, SS-12, SS-21, SS-22, SS-23) threaten US/NATO air bases in Central Europe. The US has initiated a comprehensive, long-term Tactical Missile Defense (TMD) Program to counter the threat. At the same time, the USAF has re-focused attention on the need to improve air base survivability through it Air Base Operability (ABO) Program. This research paper examines the threat, discusses the concepts and realities of TMD, and analyzes the role of ABO in TMD. In addition, it highlights the impact of the US-Soviet Treaty on Intermediate-Range Nuclear Forces upon the US TMD Program.

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PREFACE

The emergence of a new generation of Soviet short-range, conventionally-armed, tactical ballistic missiles threaten US/NATO air bases in Central Europe. To counter this threat, the US Department of Defense is embarking on a comprehensive, long-term, and potentially costly Tactical Missile Defense (TMD) Program, for which it seeks NATO support. At the same time, the US Air Force (USAF) is re-emphasizing the need to protect those same air bases from the combined air and ground threats with programs to increase survivability, and to enhance Air Base Operability (ABO). This research paper will examine the threat, will discuss the concepts and realities of TMD, and will analyze the role of ABO as a means to counter the tactical missile threat in the near-term. In addition, this paper will highlight the impact of the recent US-Soviet Treaty on Intermediate-Range Nuclear Forces on this class of weapon systems.

The USAF advocates for TMD and ABO deserve special mention; much credit is due to a few key action officers in the Pentagon who work tirelessly on programs for air base defense. I would like to thank all of them who assisted me in this project for their professional help and personal support. In particular, I would like to thank my project sponsors, Colonel Howard Guiles, LtCol Mike Carruth and Maj Mike Lee, HQ USAF/XOXXE, for their overall guidance and direction. LtCol Bob Fish and Capt Dave Schaub, HQ USAF/XOORB, provided invaluable information on US/NATO air base operability programs and initiatives. LtCol Rod Payne and Maj Ed Danahy, on the faculties of the Air War College and Air Command and Staff College respectively, were instrumental in insuring that this research paper conformed to the highest academic standards of Air University.

The role of air base operability in tactical missile defense is vitally important to the US and its allies. It offers a near-term solution to the complex problem of air base defense. The USAF has taken the lead--and must maintain the momentum--in developing effective ABO and TMD capabilities. This research paper is intended for those officials within the US Department of Defense who recommend and make ABO and TMD program decisions. It is written to provide both the layman and the expert a better understanding of the tactical missile threat, of the need for a credible air base defense against the threat, and of the role that ABO can play in that defense.

ABOUT THE AUTHOR

Major Stephen A. Fleet graduated from Northrop Institute of Technology, Inglewood, California, in June 1973 with a Bachelor of Science Degree in Aerospace Engineering. He received his commission from the Reserve Officer Training Corps program at the University of Southern California and entered the United States Air Force in September 1973. Following Air Weapons Controller training at Tyndall AFB, Florida, he was assigned to the 72d Tactical Control Flight at Robins AFB, Georgia. In January 1975, on completion of basic, water, and jungle survival training, he was reassigned to the 7th Airborne Command and Control Squadron, Clark AB, Philippines. He took part in US evacuation operations in Cambodia and Vietnam, and in the recovery of the USS Mayaguez before relocating with the squadron to Keesler AFB, Mississippi. In July 1977, he returned overseas to Yokota AB, Japan, where he served as a mission coordinator in the Reconnaissance Operations Center and, subsequently, as the Aide to the Commander, Fifth AF/US Forces Japan. In July 1980, he volunteered for a consecutive overseas tour to HQ USAFE, Ramstein AB, Germany, where he worked on a variety of US/NATO plans and programs to include: European basing, NATO command and control, the transfer of Southwest Asia responsibilities to US Central Command, and the beddown of NATO AWACS. In July 1980, he returned to the CONUS as a HQ USAF action officer in the Europe/NATO Division, DCS Plans, in the Pentagon. While there, Major Fleet worked numerous bilateral and multinational issues. In addition, he was selected for a one year exchange officer tour on the HQ Army Staff where he served as a political-military advisor to the Chief of Staff. Major Fleet has broad operational and staff experience. His professional education includes Squadron Officer School, the Air Command and Staff College, and the Marine Corps Command and Staff College. Academically, he holds a Master of Science Degree in Systems Management, and a Master's Degree in Business Administration.

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REPORT NUMBER 88-920

AUTHOR(S) MAJOR STEPHEN A. FLEET, USAF

TITLE THE ROLE OF AIR BASE OPERABILITY (ABO) IN TACTICAL MISSILE DEFENSE (TMD)

I. Problem: For more than two decades, Soviet military doctrine has focused on the use of conventional, vice nuclear, forces to win a theater-level war against NATO in Central Europe. During the 1970's, the Soviets initiated programs to improve the aging FROG-7, SS-1 SCUD, and SS-12 SCALEBOARD battlefield support missiles. By the end of the decade, the Soviets fielded the SS-21 SCARAB, SS-22, and SS-23 SPIDER. With improvements in range, accuracy, and warhead effectiveness, these missiles now offer the Soviets a potential "first-strike", conventional weapon system with which to initiate the Soviet Air Operation against critical, time-sensitive targets--including potentially vulnerable, high-value US/NATO air bases. To initially defend against it, US/NATO forces must rely heavily on air base operability (ABO) programs to: destroy attacking enemy air and ground forces, limit damage, survive, recover, and continue operating under attack or post-attack conditions. Although US/NATO defense officials recognize the need for tactical missile defense (TMD), the means to achieve it are widely debated. Moreover, the role of ABO in TMD is not understood, and needs to be clearly defined.

CONTINUED

II. Objectives: The objectives of this research paper are to address the issues related to tactical missile defense (TMD), and to analyze the role of air base operability (ABO) as a means to counter the tactical missile threat in the near-term.

III. Discussion of Analysis: The analysis begins by providing a general background on the evolution of Soviet offensive doctrine, and the emergence of the tactical missile threat. The threat is then examined in considerable detail with a discussion about the Soviet Air Operation, and a focus on specific tactical missile systems. Because of the need for a US/NATO strategy to counter the threat, this paper then highlights the operational concept for TMD, developed by the USAF and US Army--which is comprised of four key operational concept elements: passive defense measures, active defense operations, attack operations, and command and control. The analysis examines US and allied capabilities to counter the threat by describing several programs and initiatives being considered for TMD. The USAF Air Base Operability (ABO) Program is described in depth, with specific focus on the five categories of ABO: defend, survive, recover, generate, and support. The discussion of ABO is followed by a detailed, qualitative analysis of the role of ABO in TMD, resulting in specific findings, conclusions and recommendations. Finally, because of the importance of the recent US-USSR Treaty for the reduction of Intermediate-Range Nuclear Forces, a postscript highlights the agreement and its impact on TMD.

IV. Findings: Given the technical considerations, financial drawbacks, and time constraints facing other TMD alternatives, ABO offers the best, near-term solution to simultaneously counter the aircraft, missile, and ground threats. The USAF top priority ABO programs (i.e., damage assessment, explosive ordnance disposal, aircraft/air base enhancement, and alternate launch and recovery surfaces) are consistent with the requirements for TMD.

V. Conclusions: The role of ABO in TMD is important to the US/NATO. Through its ABO Program, the USAF has taken the lead in developing a defense against the emerging tactical missile threat. Air power continues to be vital to US national and allied defense strategies, and air bases remain critical, high-value, fixed targets vulnerable to Soviet tactical missiles, aircraft, and ground forces. Although Soviet aircraft deliver far bigger payloads and, therefore, represent the greater threat, tactical missiles offer considerable leverage by their potential to temporarily cripple US/NATO air defenses. In the near-term, ABO offers the best, relatively low-cost means to effectively defend

against the threat. The USAF ABO Program must be designed to counter all air and ground threats--to include the conventionally-armed, short-range, tactical ballistic missile--and priority should be given to programs and initiatives within the ABO categories of "survive" and "recover."

VI. Recommendations: HQ USAF/XOORB should identify near-term ABO programs/initiatives, and specifically address the tactical missile threat in AF Regulation 360-1. Because of the evolving nature of the threat, and the potential impact of the recent US-Soviet INF Treaty on TMD, HQ USAF should obtain a revised threat assessment from US/NATO intelligence sources. HQ USAF/SA should conduct a cost-to-benefit analysis comparing "active" TMD systems to "passive" defense measures. As the USAF focal point for TMD, AF/XOXXE should develop a continuing TMD education program and "TMD roadmap." Finally, USAF leadership should increase its advocacy for and support of essential ABO programs.

Chapter One

INTRODUCTION

During the 1970's, the Soviets began to recognize the importance and ever-increasing role of shorter-range conventional forces to win a theater war at the nonnuclear level. After ignoring the development of a new generation of shorter-range missiles in the 1960's--following deployment of the tactical free-flight rocket, and the SS-1 and SS-12 tactical ballistic missiles--the Soviets aggressively initiated several new developmental programs (SS-21, SS-22, and SS-23) in 1971. At first, these new missiles did not have the accuracy and munitions necessary for full-scale conventional use but, by the end of the decade, follow-on versions demonstrated major improvements in range, guidance, and warhead effectiveness. In fact, a 1979 USAF Tactical Air Command threat briefing acknowledged "previously, Soviet short-range ballistic missiles were considered primarily a nuclear threat. However, recent evidence indicates the Soviets may be developing a credible, conventional, short-range ballistic missile capability against a variety of threats, including airfields." (11:546-547)

By 1985, NATO officials confirmed that the Soviets were developing submunition payloads for the SS-22 and SS-23 missiles, and that the SS-21 had already been deployed with a conventional warhead. At the same time, the US Undersecretary of Defense for Research and Engineering disclosed that upgraded models of each of these missiles had "accuracies permitting their payloads to hit within 30 meters of their targets...an advancement over their predecessors by roughly a factor of twenty-five." (11:547) Soviet planners had begun to see the mass introduction of new and improved missiles as a means to achieve decisive effects on the battlefield, particularly in the early stages of a conflict.

In the Winter of 1986, Dr. Manfred Woerner, Minister of Defense, Federal Republic of Germany, warned fellow NATO defense ministers that with the introduction of the modernized SS-21, SS-22, and SS-23 missiles to Europe:

> The Soviet Union is thus attaining a qualitatively new capability for executing the "conventional fire-strike"--namely, the capability to destroy with conventionally-armed missiles a large number of

> important military objectives in NATO territory that must today be assigned to Soviet nuclear weapons or to fighter-bombers in a nonnuclear role. Such targets include NATO airfields...and by concentrating missile strikes on prime NATO targets over massively attacking Warsaw Pact air and ground formations, the Soviet Union could prevent, delay or obstruct NATO response options in the critical initial phase of a conflict. (18:15)

Minister Woerner urged NATO officials to search for a means to cope with this new threat--insisting that a defense against attacking missiles would be consistent with, and reinforcing of the defensive nature of the alliance. He perceived a defense comprised of: passive measures of protection, the interception of incoming missiles, and the destruction of enemy missile systems before launch. Such a defense need not be comprehensive or impenetrable, he concluded, but must be nonnuclear and highly survivable to provide point defense of priority targets without being saturated. (18:17) The resultant NATO concern over this new and potentially serious threat led to increased US emphasis on anti-tactical missile/tactical missile defense programs.

In January 1987, US Deputy Secretary of Defense, William H. Taft IV, directed the Department of Defense to begin developing a comprehensive anti-tactical missile plan/program to protect NATO forces from the Soviet tactical missile threat. (15:18) In response to this policy guidance, the US Army (as lead Service) formed a joint Tactical Missile Defense Special Task Force at Redstone Arsenal, Huntsville, Alabama, to develop a master plan which would identify the requirements and potential programs for a tactical missile defense system. At the same time, the Senate Armed Services Committee endorsed Department of Defense efforts to collaborate with NATO and non-NATO allies to develop an "extended air defense system", and authorized $50 million in FY88/89 funds for an anti-tactical missile program. In addition, because some in Congress believed that the "Star Wars" research program could prove technology useful for tactical missile defense, the Senate authorized $73 million to the Strategic Defense Initiative Organization for anti-tactical missile experiments and demonstration projects. (26:138; 8:33) The US Army and USAF, meanwhile, began developing an "Operational Concept" for tactical missile defense, as part of the overall US/NATO defense against the Soviet Air Operation.

Today, the Soviet Air Operation is designed to exploit the advantages of surprise, speed, aggressiveness, concentration of effort, combined arms, and depth. Instead of trying to defeat US/NATO forces in the air, the Soviets intend to take the fight directly to the air bases themselves, with coordinated attacks of missiles, aircraft, and special operations forces. (4:33-34)

The modern conventional Soviet Air Operation has replaced the initial mass-nuclear strike in Soviet offensive doctrine. As a result, Soviet short-range missiles can no longer remain dormant; the success of subsequent ground operations depends on the Soviet Air Operation achieving widespread pre-emptive shock effect on unprepared NATO forces. To achieve this, an attack with conventionally-armed missiles (potentially with high explosives, mines, bomblets, incendiaries, or fuel-air explosives) would likely precede the massive waves of Soviet fighters/bombers expected during the first few hours of a war. (11:550; 4:34) Based on this doctrine, Soviet planners have adopted a new fire-support strategy for tactical missiles which calls for conventional strikes against deep-based NATO aircraft on the ground, and nuclear weapon systems. (11:551) In support of this strategy, the Soviets have invested in a new generation of missiles which could be used in a pre-emptive, conventional role as an integrated part of the Soviet Air Operation.

To initially defend against the Soviet Air Operation, US/NATO forces must rely heavily on air base operability (ABO) programs. On 31 December 1986, HQ USAF published AF Regulation 360-1, Air Base Operability, to establish policies and to explain procedures for planning and operating the USAF ABO Program. The mission of the ABO program is "to provide Air Force installation commanders with the capability to destroy attacking enemy air and ground forces, to limit damage, and to survive, recover, and continue to operate under attack or post-attack conditions according to the threat and geographic location." (20:3) The major objectives of the program are: to defend air bases and critical facilities, to minimize the effects of an attack (i.e., to survive), to provide a recovery capability, and to provide a command and control structure. The program applies to all USAF installations in the US, as well as overseas at main operating bases, collocated operating bases, forward operating locations, aerial ports of debarkation, and bare bases. (20:3) Air base operability is critical to the survival of US/NATO forces in Central Europe; however, its capability to counter the tactical missile threat needs to be clearly defined and better understood.

In summary, the emergence of a new generation of Soviet short-range, tactical ballistic missiles, and the potential vulnerability of high-value air bases to the integrated Soviet Air Operation have become sensitive and highly controversial issues within the US/NATO defense communities. The following chapters of this research paper will analyze these issues in greater detail in an effort to determine the role of air base operability in tactical missile defense.

Chapter Two

THREAT

Air bases today can be attacked by an ever-increasing number of delivery systems with a wide range of conventional, nuclear, chemical, and biological munitions. Moreover, existing and emerging technologies have improved the capabilities of both the systems and their munitions. Aircraft and missiles have become more accurate, faster, and more effective over greater ranges. Soviet doctrine has increased the emphasis on air base attack and, consequently, more forces are being designed and fielded with air base attack capabilities. (4:2) The purpose of this chapter is to examine the emerging threat to air bases presented by the Soviet short-range, tactical ballistic missile.

The present generation of Soviet short-range ballistic missiles, such as the SS-21 SCARAB, the SS-23 SPIDER and the SS-12/22, were developed in the 1970's to replace the older generation FROGs, SCUDs and SCALEBOARDs. Although, historically, NATO considered this class of missile to be primarily a theater nuclear threat, evidence began to mount in the late 1970's that these new missiles possessed a credible conventional capability as well. By 1978, some intelligence estimates had indicated the deployment of the SS-21 with a conventional warhead. (5:103) This revelation prompted NATO planners to begin considering ways to counter the new threat. In fact, NATO's Refined Program for Air Defense, 1979, recommended that future enhancements of the air defense system should include an anti-missile capability and, in 1986, NATO's defense ministers directed that the future NATO Integrated Air Defense System be capable of responding to the threat of tactical missiles. (13:94)

To appreciate NATO's concern, it is necessary to first understand the US and allied perceptions of the probable Soviet concept of employment for these missile systems in light of the unique defense problems in Central Europe. Unfortunately, US/NATO forces enjoy little defense in depth. In fact, most of NATO's high-value assets in the Central Region are clustered within 500 kilometers of the inter-German border--within striking range of Soviet tactical missiles based in East Germany and Czechoslovakia (see Figure 1).

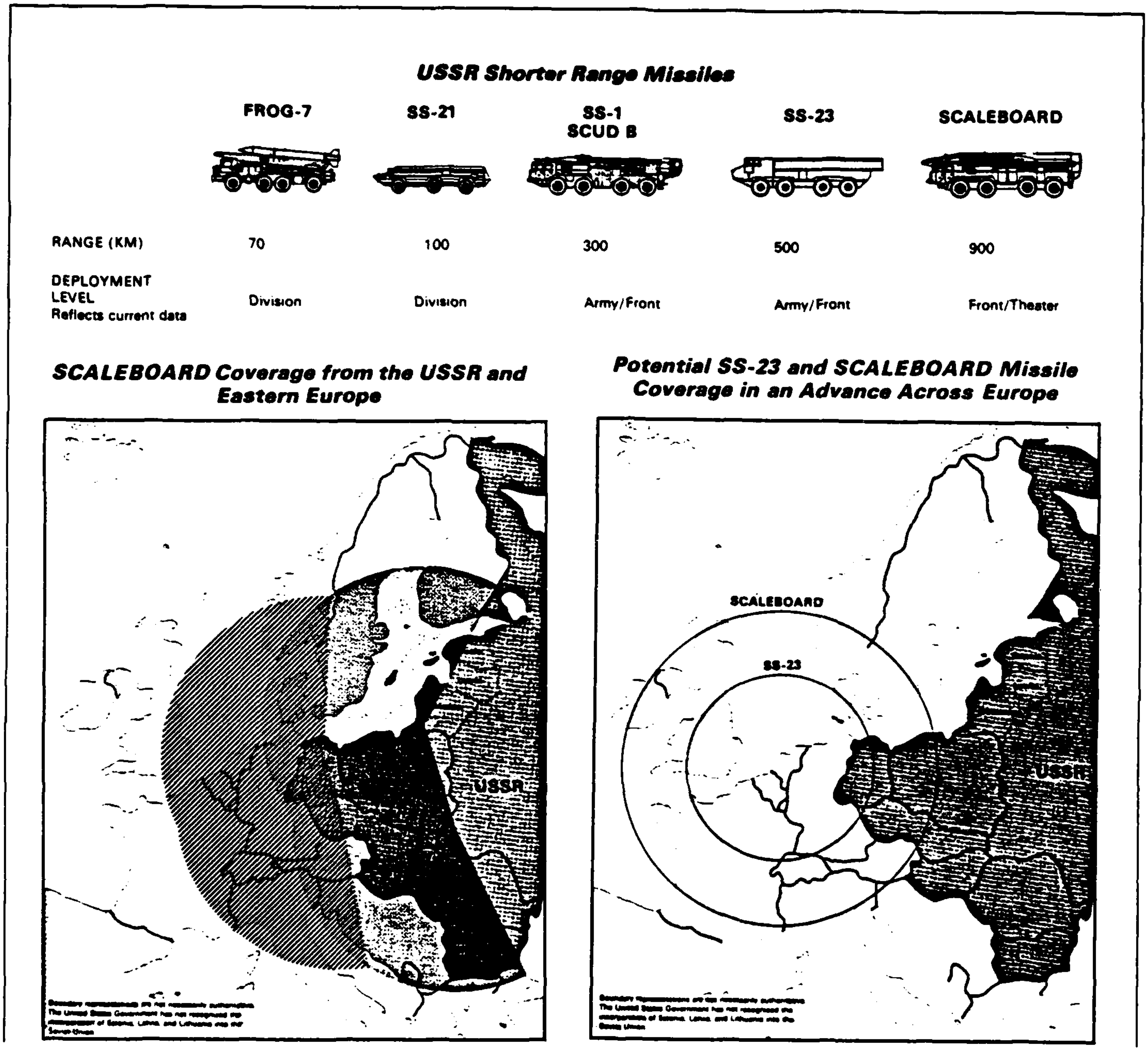

Figure 1. Soviet Shorter-Range Tactical Ballistic Missiles (Source: US Department of Defense Soviet Military Power 1987)

Furthermore, because NATO's nuclear arsenal poses the greatest threat to the Soviets, the 11 main operating bases in the Central Region with "dual-capable" (i.e., conventional and nuclear) fighters/bombers represent high-priority targets for the Soviet Air Operation discussed in Chapter One. (11:552)

In addition to these nuclear targets, a missile attack against US/NATO air bases with defensive counterair aircraft (i.e., air-to-air fighters) would be necessary to allow for the penetration of massive waves of Soviet fighters/bombers. The purpose of a Soviet conventional missile attack against an air base complex would not be to destroy it but, rather, to simply delay or disrupt US/NATO air operations long enough to prevent an effective defense against follow-on Soviet aircraft--which could indeed inflict serious damage. (4:34) Consequently, the capability and flexibility offered by the tactical ballistic missile lends credibility to the Soviet Air Operation concept.

In the overall defense of the alliance, the importance of NATO's air bases cannot be overstated. The outcome of any future conventional conflict will be decided by the side that can achieve and maintain air superiority--and aircraft are the key. The best way to destroy NATO's aircraft is to catch them on the ground and, to do this, the Soviet Air Operation would use a combination of fighters and bombers, highly trained commandos (e.g., Spetznaz), and tactical ballistic missiles, coordinated in a massive offensive-counter-air campaign. A cleverly orchestrated combination of resources against key airfields could very well cripple NATO's airpower early in the conflict. (13:89)

The Soviets have and are expected to continue to achieve significant gains in missile technology and "smart" submunitions. In the process, many types of Soviet missiles could potentially be used as conventional weapon systems. Initially in a conflict, conventionally-armed missiles offer the Soviets wider employment options. (29:2) Former Soviet Chief of the General Staff, Marshal Ogarkov, stated in 1984:

> Rapid changes in the development of conventional means of destruction and the emergence [of new technologies] make it possible to increase sharply (by at least an order of magnitude) the destructive potential of conventional weapons, bringing them closer to weapons of mass destruction in terms of effectiveness. The sharply increased range of conventional weapons makes it possible to extend, immediately, active combat operations not just to border regions, but to the entire enemy territory, something which was not possible in past wars. (29:3-2)

The new generation of Soviet missiles (i.e., the SS-21, SS-23, and SS-12/22) offers greater range than its predecessors. Because of the lack of depth on the European battlefield (as shown in Figure 1), these weapon systems could conceivably reach nearly all of the US/NATO air bases and other critical military installations in the Central Region. Defense analysts in Europe

share the view of many within the US defense establishment that "the emergence of an effective conventional means of destruction, along with active defenses, indicates that Soviet military planners have adopted a blitzkrieg strategy." (5:104) French General Pierre Gallois, who developed France's nuclear forces, observed that "because of the improved accuracy of short-range missiles, the Soviets could destroy the roughly 225 critical target sets in Europe with conventional weapons or low-yield nuclear bursts, and thus militarily incapacitate NATO." (5:105) Likewise, within the US defense community, the Undersecretary of Defense for Policy, Fred Ikle, has argued that tactical ballistic missiles could provide the Soviets with "...a conventional strike capability that could destroy a significant part of NATO's military capability...such as airfields...that heretofore could be attacked in a surprise attack only by crossing the nuclear threshold."

In summary, as a result of Soviet technological improvements and innovation, the US and its NATO allies are faced with a new threat that appears to achieve many of the aims of a successful Soviet Air Operation--but with considerably greater flexibility, speed, and surprise. (32:4-5) To better illustrate the scope and nature of the threat, specific missile systems are described below. In addition, Table 1 highlights their characteristics.

FROG-7 BATTLEFIELD SUPPORT MISSILE

FROG, an acronym for "free rocket over ground", was introduced in 1965 as a family of unguided missiles widely deployed with both Soviet and Warsaw Pact ground troops. (12:11) The Soviets are replacing FROG with the more accurate, longer range SS-21s in some divisions opposite NATO. About 500 FROG and SS-21 launchers are opposite NATO, with another 215 in the Far East, 100 opposite Southwest Asia, and 75 more in strategic reserve. (25:41) The FROG marked a new departure in vehicle design, using a modern, wheeled, erector launcher. The missile itself is of single-stage design with a cylindrical warhead the same diameter as the missile. The FROG-7 is the last of the unguided ballistic series. The main nozzle of the single stage rocket motor is surrounded by a ring of much smaller nozzles. It is operational in the armies of most Warsaw Pact countries, as well as Egypt, Iraq, Libya, North Korea, and Syria. Some of the missiles, equipped with high explosive warheads and potentially guided, were fired against Israel in the 1973 Arab-Israeli war. Each Soviet tank and motorized rifle division has a FROG-7/SS-21 battalion consisting of battalion HQ, HQ battery, and two firing batteries each with two launchers and one reload missile per launcher. (1:42-44) (See Table 1)

SS-1 SCUD BATTLEFIELD SUPPORT MISSILE

The SS-1 SCUD has been operated by Soviet forces and clients for many years, continually being improved/modified. The latest model, the SS-1c (to be replaced by the SS-23) was fielded in 1965 with a longer range than the SS-1b, but thought to have less accuracy. SCUD is a land-mobile system of single missiles carried on a transporter-erector-launcher (TEL) vehicle. Hydraulically actuated rams raise the missile to the upright position for launching. The missile is liquid propelled which requires about one-hour preparation time. Re-supply, loading and weather vehicles accompany SCUD batteries. SCUD is operational with Soviet/Warsaw Pact forces, and reportedly in Egypt, Iraq, Libya and Syria. (1:42-44) More than 500 launchers are located opposite NATO, 100 along the border with China, 75 in Southwest Asia, and 25 in strategic reserve. (25:41) The missiles are deployed in brigades assigned to armies and fronts, each with 12 to 18 launchers. SCUD is a well-regarded system. (See Table 1)

SS-12 SCALEBOARD BATTLEFIELD SUPPORT MISSILE

The SS-12 is transported and launched from a cross-country truck similar to the SCUD TEL. Normally found at front level, SCALEBOARD brigades have two or three battalions, each with six launchers. In 1985, the US reported deployment of a more accurate version of the missile capable of employing non-nuclear warheads. (25:41) Unlike SCUD missiles, which are exposed to view in transit, SCALEBOARD is enclosed in a ribbed split metal casing which is elevated with the missile into firing position. Guidance is assumed to be inertial and, thus, suitable for use with a missile that is elevated from horizontal to vertical shortly before firing. (1:42-44) SCALEBOARD is fully operational in the USSR, but its precise role is unknown. In 1984, it was deployed forward to Eastern Europe with Soviet formations, now in position to strike deep into Western Europe. More than 60 launchers face NATO, 40 are along the border with China, and a battalion is opposite Southwest Asia, with another battalion in strategic reserve. (25:41) SCALEBOARD is to be replaced by the SS-22. (See Table 1)

SS-21 SCARAB BATTLEFIELD SUPPORT MISSILE

The SS-21 was first deployed in the USSR in 1976 and began replacing the FROG-7 (about four per month) in Eastern Europe in 1981. It is a mobile system and represents considerable Soviet modernization efforts. Analysts believe that the increased accuracy and range of this missile allows the use of conventional warheads against NATO targets well beyond the main fronts. (12:11-12) The SCARAB is launched from an amphibious transport

vehicle (similar to the SA-8 SAM), and while being transported, the missile is protected within the hull of the vehicle. By 1985, the SS-21 had almost replaced the FROG-7s in East Germany and had been supplied to Czechoslovakia and Syria. Nearly all of the 130 SS-21s presently deployed have been assigned against NATO. (25:66) The SS-21 inventories in service worldwide will likely increase. Soviet tactical doctrinal changes in the early 1970's (away from tactical nuclear weapons) are said to be responsible for development of a true "dual-capable" missile. Estimates of the accuracy of the SS-21 vary from 50-100 meters. With sufficient accuracy, such systems could be used to attack NATO airfields, command and control centers, and other critical targets with conventional high explosives or cluster warheads. There may be as many as seven operational models of this missile, varying in warhead types. The system reaction time for a loaded launcher is about 15 minutes, with a 70 minute reload time, and as many as seven reload missiles for each launcher The SCARAB is normally deployed like the FROG. (2:51-53) (See Table 1)

SS-22 BATTLEFIELD SUPPORT MISSILE

In 1973, the Soviets began modifying the SS-12 SCALEBOARD into a more accurate missile. Referred to by NATO as the SS-22, it entered service in 1979. NATO later decided the modification was not extensive enough to constitute a new missile, but the official designation SS-12/mod(ification), is now usually referred to as the SS12/22. Beginning in 1984, 54 SS-12/22s were forward deployed in Eastern Europe, with 120 launchers deployed worldwide. The new missile is transported and launched from a vehicle similar to the SS-12 and, similarly, is deployed with 12 to 18 launchers per brigade at front level. (12:11) (See Table 1)

SS-23 SPIDER BATTLEFIELD SUPPORT MISSILE

The SS-23 was developed in 1975 as the replacement for the SCUD, which can carry conventional high explosives, chemical or nuclear warheads. The battlefield reaction time of the SS-23 has been reduced and refire time has been cut to almost half that of the SCUD. (12:11) With a much greater range and accuracy than the SCUD, the SS-23 missile is transported and launched from a vehicle similar to the SS-21 and, as such, is kept within the hull of the vehicle until required for launching. (1:42-44) Like the SCUD, the SS-23 is deployed with Soviet armies and fronts in brigades of 12 to 18 launchers. The Soviet Union deployed the first SS-23 brigade in 1985 in the Belorussian Military District, and currently there are about 20 launchers deployed on Soviet territory. By the end of the decade, some analysts estimate that the SS-23 would replace all SCUDs in Eastern Europe. (12:11; 25:123) (See Table 1)

Designation	Weight(kg)	Warhead	Propulsion	Range(km)	Guidance
FROG-7	2000	HE,N	Solid	60-70	Unguided
SS-1b (SCUD A)	4500	HE,N	Liquid	80-150	Command
SS-1c (SCUD B)	6300	HE,N	Liquid	160-280	Inertial
SS-12 (SCALEBOARD)	6800	N	Liquid	800	Inertial
SS-21 (SCARAB)	---	HE,N	Solid	120	------
SS-22 (SS-12/22)	---	HE,N	----	900	------
SS-23 (SPIDER)	---	HE,N	Solid	500	Inertial

HE: High Explosive
N: Nuclear

Table 1. Soviet Tactical Land-Based Surface-to-Surface Missiles (Source: Janes Weapon Systems 1986-87)

Finally, no description of the Soviet tactical missile threat would be complete without highlighting a few of their limitations when employed in a conventional role. First of all, a missile such as the SS-23 is costly, and it can deliver only about a 1000 kilogram warhead--even smaller with the addition of an improved terminal guidance system. (9:6) Aircraft have much better cost-to-payload ratios and can be re-used. Missile accuracies are based on fixed targets, whereas, mobile targets present different technical challenges. With regard to warheads, the dispersal of submunitions is a more complicated problem for missiles than for aircraft, and the development of penetrating warheads for attacking hardened targets means further payload reductions. Despite these limitations, Soviet doctrine continues to emphasize surprise, and conventional missiles offer the Soviet planner the capability to strike targets in the rear with great speed, and virtually-assured penetration. As a result, tactical missiles would be well suited against high-value, time-critical targets (e.g., air bases), which might be temporarily paralyzed by small quantities of munitions--allowing time for greater payloads to be delivered by aircraft. (32:8-10) Thus, the need for an effective tactical missile defense!

Chapter Three

TACTICAL MISSILE DEFENSE OPERATIONAL CONCEPT

Headquarters, United States Air Force (HQ USAF) and Headquarters, Department of the Army (HQ DA) have developed a concept describing the operational capabilities required to counter the emerging tactical missile threat. (23:2) This concept will serve as the basis for a Joint Operational Concept, to be considered by the Joint Chiefs of Staff (JCS) in early 1988 (21:1), along with an umbrella Joint Operational Requirements Statement for the [US] Tactical Missile Defense Program. (22:i) Once approved by the JCS, both the concept and requirements statement will be used by the Services as guides "for the evolutionary development of new or improved doctrine, training, force design, and materiel systems through the year 2005." (23:2) Because of the potential impact on USAF programs/initiatives, the purpose of this chapter is to highlight the operational concept for tactical missile defense (TMD).

Although the term tactical missile is used to describe a broad range of aerial delivery vehicles, to include tactical ballistic missiles, air-to-surface missiles, cruise missiles, and remotely piloted aerial vehicles, the operational concept focuses on the conventionally-armed variants of the short-range tactical ballistic missiles discussed in Chapter Two. Furthermore, the concept addresses only those short-range tactical ballistic missiles facing NATO's Central Region. Similar threats, however, could appear worldwide and on any level of the spectrum of conflict. (23:2)

The objective of TMD is to protect friendly forces/critical assets from the threat, and to complicate enemy wartime planning. It must be a coordinated and integral part of the operational commander's air and ground campaigns aimed at destroying or disrupting the enemy's tactical missile systems/operations. Successful TMD operations require careful preparation, primarily through friendly intelligence collection activities--to allow for a smooth transition from peace to war. Critical to this phase is the need to identify where enemy missiles are located, which critical friendly assets will be protected, and what resources will be used to counter the threat. During the transition to war, TMD resources must focus on providing launch detection and

warning information to friendly forces. Once a launch is detected, TMD activities can then shift to: active defense operations to destroy missiles in flight, attack operations to destroy/disrupt enemy missile systems on the ground, and/or sustaining operations to suppress continued operations. (23:4-9)

Tactical missile defense is comprised of the following four key concept elements: passive defense measures, active defense operations, attack operations, and command and control. (23:9) Because the elements must be coordinated and integrated to be effective, the following discussion will describe each in detail.

PASSIVE DEFENSE MEASURES

Passive defense measures are designed "to degrade the enemy's ability to target [friendly forces], reduce vulnerability to an enemy attack, and reconstitute and recover the capability to conduct combat operations following an attack." (23:10) They are a relatively cost-effective way to protect friendly combat forces by reducing the effects of a tactical missile attack. This can be accomplished by degrading the enemy's ability to target friendly forces/assets, and by reducing their vulnerability to attack. Reconstitution and recovery operations also play an important role. Principal passive defense measures are: attack warning; reducing targeting effectiveness through operations security; deception and mobility; reducing vulnerability through hardening, redundancy and dispersal; reconstitution and recovery operations. (23:10-12) The USAF Air Base Operability (ABO) Program, designed primarily to counter the threat of manned fighters and bombers, is an excellent example of passive defense. Because ABO measures may also be effective against the tactical missile threat, they will be discussed in greater detail in the following chapters of this report.

ACTIVE DEFENSE OPERATIONS

Active defense operations are designed "to destroy tactical missiles in flight, thus preventing successful attacks against critical resources and adding uncertainty to enemy planning." (23:10) They directly protect critical resources and complicate the enemy's ability to plan a coordinated, combined arms offense. Active defense measures do not have to be impenetrable but should complement passive defense measures, and attack operations to be effective. Surface, air, or space-based kinetic/directed energy systems may be used to destroy missiles immediately after launch or late in flight. Due to the great speed, elevation and re-entry parameters of incoming missiles, destroying them in either flight profile requires near-real-time launch information

and immediate response. As a result, target acquisition, detection, and tracking systems must be linked to defensive attack assessment systems. (23:12) PATRIOT is an example of a missile system being modified and fielded for active defense operations. In addition, the US Strategic Defense Initiative Organization is investigating new interceptor technologies which may be useful in tactical missile defense operations. (15:1)

ATTACK OPERATIONS

Attack operations are designed "to destroy or disrupt tactical missile launchers or their supporting command and control, and logistical structure, thus precluding or degrading subsequent enemy launch operations." (23:10) They protect the force by denying subsequent launch and, thus, reduce stress on defensive systems. However, because enemy tactical missile systems are dispersed, mobile, quiet, and redundant, attacks directly against them would likely be difficult. Attack operations are by nature "counterforce" in that their aim is to destroy/disrupt tactical missile launchers, command and control, and supporting infrastructure beyond friendly lines. Attack assets could encompass a broad range of friendly resources to include surface-to-surface, air-to-surface, and space-to-surface weapon systems, electronic combat assets, and ground/special operations forces. (23:13) Given that friendly sensor systems could locate the threat and that the command and control network could direct the attack, new systems such as the Army Tactical Missile System, or the USAF F-15E with the Modular Standoff Weapon could be useful in TMD attack operations. (15:1)

COMMAND AND CONTROL

Command and control [systems] are designed "to provide warning, predictive intelligence, resource allocation, and near-real-time targeting to forces conducting TMD operations." (23:14) In addition, command and control is the exercise of authority and direction by commanders over forces assigned TMD tasks through an arrangement of personnel, communications, equipment, facilities, and procedures to plan, direct, coordinate, and control forces. Each of the three key concept elements discussed above require at least one or more of the following command and control functions: prediction, detection, warning, acquisition, tracking, identification, communications, and/or data transmission. Command and control is the critical link between the passive, active, and attack elements of TMD--to provide timely assessment of the threat, rapid warning, targeting information, and mission tasking. "For each concept element, the command and control system must provide rapid communications

between intelligence assets, a fusion capability, a decision-making process, warning systems, and operational means." (23:15) Because of the unique characteristics of the threat, which allow little if any warning, a new and automated "decide-detect-engage" decision-making methodology may have to supercede the traditional "detect-decide-engage" approach. Nevertheless, the longstanding principles of centralized command, decentralized control and execution, and coordinated effort should still apply to TMD operations. "Command and control is built on existing or planned command and control systems, conducted simultaneously, and integrated with other operations in accordance with joint and combined procedures." (23:10) Therefore, system designs for TMD should build upon the existing or planned theater architectures (e.g., NATO's Air Command and Control System) to take full advantage of all joint and combined capabilities. (23:15) Furthermore, future capabilities such as the Joint Surveillance and Target Attack Radar System--designed to acquire and track static and moving ground targets--should be integrated into the theater TMD command and control system/subsystem. (15:1)

The effective coordination and integration of the four TMD elements discussed above requires careful planning, control, and execution. Commanders, together with their operations and planning staffs, must clearly understand their roles and responsibilities in TMD operations. Planning for passive defense measures must be conducted at all levels, whereas, the planning for active defense and attack operations begins with the joint or combined force commander's overall warfighting concept, priorities, apportionment decisions, and allocation of resources. Theater air and ground campaigns must be carefully coordinated and integrated through a responsive system of command and control. (23:12-14) The centralized command of TMD operations must manifest itself through decentralized control to the lowest possible organizational levels. Finally, unit commanders at all echelons must execute TMD operations in accordance with joint and combined doctrine, procedures, and rules of engagement. (23:13)

In summary, the emerging tactical missile threat cannot yet be countered by any single technical solution, and will require capabilities never before deployed with operational forces. In accordance with the US Army/USAF operational concept, "it must be met with a synergistic, balanced mix of land, air, and space capabilities." (23:16) The four key elements discussed above (i.e., passive defense measures, active defense operations, attack operations, and command and control) provide the framework for TMD operations. To achieve the capabilities desired for effective TMD will require close and coordinated efforts within the US Department of Defense and among US allies.

Chapter Four

TACTICAL MISSILE DEFENSE CAPABILITIES

The operational concept discussed in the previous chapter is to be used by the Office of the Secretary of Defense, the Joint Chiefs of Staff, and the Services to evaluate current US capabilities to meet the tactical missile threat, to identify shortfalls, to adjust ongoing programs and initiatives, and to serve as a baseline for present and future research and development efforts. In addition, the concept should be used by US representatives in allied fora to arouse interest and to influence the design of allied TMD systems as well. The purpose of this chapter is to briefly highlight some of the US programs and initiatives being considered for TMD--classified within each of the four key operational concept elements.

PASSIVE DEFENSE CAPABILITIES

Recall from the previous chapter that passive defense measures are required to "reduce an enemy's target acquisition capability, reduce the vulnerability of critical assets to attack, and provide a force reconstitution capability following an attack." (22:4) Camouflage, concealment, hardening, mobility, deception, and dispersal are examples of the types of passive defense measures available to friendly forces. Moreover, timely missile attack warning information provided by the theater command and control system could significantly increase the successful application of these passive defense measures. (22:4)

The USAF Air Base Operability (ABO) Program, designed primarily to counter the threat of the fighter/bomber, is the best example of an ongoing, cost-effective, and highly visible program capable of providing the US (and its allies) with an effective passive defense. Passive measures alone, however, will not protect friendly forces or critical assets from a tactical missile attack. Although they can induce targeting errors and complicate the enemy's planning scheme, the increased numbers and improved accuracies of newer missiles provide the attacker with the capability to still suppress or damage critical targets. (22:4) Consequently, friendly forces must rely on the integrated employment of the remaining key elements of the TMD system.

ACTIVE DEFENSE CAPABILITIES

To further protect critical resources and to add greater uncertainty to the enemy's overall plan of attack, friendly active defense capabilities would be necessary to destroy enemy missiles in flight. Ground, sea, and air-launched systems could potentially keep enemy missiles from hitting their targets. Active defense systems would not be impenetrable but would, however, complement passive defenses and attack operations within an integrated TMD structure. (22:4) In the near term, the most viable candidates for active defense are the "missile-on-missile" engagement systems, despite the fact that one of the most difficult challenges facing weapons designers today is how to build a missile that is agile and accurate enough to destroy attacking warheads. The PATRIOT surface-to-air missile, upgraded with an anti-tactical missile capability, offers the best example of a system presently being developed and fielded for near-term active defense operations. In addition, the US Army, the Strategic Defense Initiative Organization, and allies are investigating and developing new interceptors and interceptor technologies which could play a role in TMD. (15:1)

In September 1986, a PATRIOT missile in the first phase of its upgrade successfully intercepted a US Army LANCE missile. Known as PAC-1, the software modification to the system provides the missile with an improved upward trajectory, and the radar with a high-angle search capability. The second upgrade to the system, known as PAC-2, was tested in November 1986 against another PATRIOT missile (with radar characteristics similar to a Soviet missile), and involved modifications to both the warhead and fuze to increase the missile's intercept capability. The result of the upgrade will be to make the system "dual capable" against both aircraft and tactical missiles. (3:1) The US, West Germany, the Netherlands and Italy will all own PATRIOT. (10:22)

In the long term, active defense systems could include a number of allied missile systems with larger area coverage such as Israel's ARROW, Britain's LANDWOLF, or France's ASTER--a revolutionary new design using "direct force controls" or lateral maneuvering rockets in combination with traditional flight controls. (6:6) In addition, a number of new US-developed interceptors show promise for TMD. The Extended Range Intercept Missile, a longer-range follow-on to the US Army's Flexible Lightweight Agile Guided Experiment (a kinetic energy missile), has successfully intercepted a LANCE and might be fitted onto existing Army missile launchers. (7:6) In addition, a High Endoatmospheric Interceptor is under development. (10:22) To entice allies to join the US in research and development efforts, Congress ordered, in 1986, that $50 million in SDI funds be used to co-develop anti-tactical missile systems. (17:1)

At the outset of hostilities in Central Europe, active and passive defense measures would be the only means available to protect US/NATO forces and critical assets from a tactical missile attack. However, because each Soviet tactical missile launcher is capable of conducting additional attacks, which could potentially saturate the defensive capabilities described above, friendly forces must be able to destroy the re-shoot capability of the enemy tactical missile force through counterattack.

ATTACK CAPABILITIES

Attack operations which destroy or degrade tactical missile launchers, command and control, and supporting logistics infrastructure can deny the enemy the capability to re-use those systems and, thereby, disrupt his entire scheme of fire support. Attack capabilities may include: surface-to-surface, air-to-surface, and space-to-surface weapon systems; electronic combat assets, and ground/special operations forces. (22:4)

Specific resources for attack operations have not been clearly identified, however, a number of existing/programmed systems could potentially perform the mission. The USAF TMD program managers maintain that the enemy's tactical missile system represents but one class of target within the commander's sizeable air interdiction and offensive counterair target set. US and allied aircraft, such as the F-16 or Tornado armed with a new generation of standoff weapons, offer a credible tactical missile attack capability--provided that friendly sensors can locate the threat, and that the command and control system can direct the attack. On the horizon, the F-15E with the Modular Standoff Weapon may also prove useful in TMD attack operations. One possible surface-to-surface system being looked at by the US is the Army Tactical Missile System. (10:22)

Attack operations, while offering an attractively high payoff, would be difficult due to the enemy's ability to hide his tactical missile systems. As a result, a responsive command and control capability is essential to support near-real-time targeting, and attack assessment. National command, control, communications and intelligence assets may be required to augment theater air/ground-based attack systems. (22:4)

COMMAND AND CONTROL CAPABILITIES

Command and control is the critical link in an effective TMD system. As the key operational concept element upon which the other three must completely rely, it makes TMD an integral, and supporting part of successful combat operations. The command and

control system for TMD must be able to provide: timely assessment of the threat, rapid dissemination of attack warning, cueing, targeting data, and mission tasking orders. (22:5) The command and control system is probably the most important (yet least understood) of all the mission elements and, as such, offers the greatest opportunities for the development of new capabilities.

In February 1988, the US Army's Strategic Defense Command plans to launch a two-year program to examine command and control capabilities for TMD. The proposed $34 million program would be co-sponsored by the Strategic Defense Initiative Organization, and would culminate in a demonstration of anti-tactical missile systems. In preparation for the demonstration, technicians would attempt to integrate acquisition radars with tracking, and other command and control equipment to operate air defense systems during an actual attack scenario. Aimed at enhancing TMD capabilities in Europe, the scenario would simulate a tactical missile attack against an air base to determine command and control requirements for active defense operations. (9:3,36)

A number of existing or programmed command and control systems could take part in this demonstration--if made available by the owning agencies and appropriately modified for TMD. For example, the USAF's new AN/TPS-43E search radar (with ultra-low sidelobe antenna) could possibly complement the upgraded PATRIOT radar. In addition, the prototype Joint Surveillance and Target Attack Radar System, and US E-3 AWACS (modified to include multi-mode radar with programmable signal processor, and sector scanning) could also prove TMD-capable. Each of these representative subsystems would potentially support the overall command and control system in providing friendly forces with: early warning and impact predictions for passive defense, long-range acquisition/precise cueing for active defense, launch point coordinates for attack operations, and summary data for detailed intelligence analyses.

Regardless of the outcome of the above research, development, and demonstration efforts, considerable work is required within the US defense community, and among US allies before a viable command and control system can be fielded--a system which can integrate the key operational concept elements of passive defense, active defense, and attack operations into a credible, and effective TMD system. That entire process is likely to be long term. As a result, the remaining chapters of this research paper will focus on the USAF ABO Program as a means to achieve a passive, near-term defense of US/NATO air bases in Central Europe against the tactical missile threat.

Chapter Five

AIR BASE OPERABILITY

Air power is critical to US national and allied defense strategies. Yet, despite its importance, relatively little attention has focused on the one key constant in the air power equation--the air base. Assistant Secretary of the Air Force for Readiness Support, Tidal McCoy, recently observed that the "Air 'force' consists of three elements: the air base from which the aircraft are launched and recovered, the aircraft themselves, and the air-to-air and air-to-ground munitions that make the sorties productive... [and] that all three must be present for air 'force' to exist." (14:52) Secretary of the Air Force, Pete Aldridge, believes that during the past few years, the USAF has done a commendable job at procuring new aircraft and munitions, however, "the time has come to place renewed emphasis on the air base itself." (14:52) The purpose of this chapter is to briefly look at the current USAF Air Base Operability (ABO) Program to set the stage for subsequent analysis of the role of ABO in TMD.

Recall from Chapter One that the major objectives of the USAF ABO Program are: to defend air bases and critical facilities, to minimize the effects of an attack (i.e., survive), to provide a recovery capability, and to provide a command and control structure. (20:3) For successful theater air operations, the air commander must have combat air bases capable of employing and sustaining effective air power at pre-planned sortie rates. To ensure the integrated operability of his assigned missions prior to, during, and following an attack, ABO provides the installation commander with the flexibility to employ a wide range of capabilities to prevent, limit or quickly repair damage to his air base. (30:1)

Air base operability programs, are designed to counter the conventional, nuclear, biological, and chemical wartime threats. They are identified within the following four main categories: defend, survive, recover, and generate--sometimes, referred to as the "four pillars" of ABO. A fifth category, support, transverses the others, and provides the foundation for a coherent and cohesive ABO program. (30:1; 20:11) The following discussion will describe each of the five categories in detail.

DEFEND

According to Assistant Secretary Tidal McCoy, the purpose of defense is to destroy enemy aircraft, tactical missiles, and ground threat forces before they can harm the air base. (14:54) It is achieved using attack assessment and attack warning systems, air defense forces, and air base ground defense forces. The USAF ABO Program (AF Regulation 360-1) provides for the "conduct of air defense operations to destroy attacking aircraft and missiles, and to disrupt or reduce the influence of enemy air operations directed against air bases." (20:11) In addition, ground defense operations would be conducted to defeat small enemy units, and to provide limited defense against larger (battalion-size) forces.

Attack assessment/warning systems provide immediate warning to air base personnel. Area air defense is provided by friendly surface-to-air missiles/gun systems (e.g., PATRIOTs) and fighters (e.g., F-15s), giving medium-to-long-range defensive coverage of air bases. Normally, these assets are not directly controlled by an installation commander but, instead, by a regional/area air defense commander. Point air defense systems (e.g., ROLAND, RAPIER and STINGER) are designed to protect individual air bases or other critical assets. Air base ground defense consists of local security measures, and forces to counter an enemy ground attack. Host nation or US Army ground forces provide security outside air base boundaries, while USAF security forces are responsible for internal defense. (20:11) The USAF air base ground defense program includes detection/communication systems, weapons, munitions, vehicles, manpower and training. (30:2)

SURVIVE

Air bases must be able to survive an attack. (14:54) Survival requires passive defense measures designed to "reduce the ability of the enemy forces to identify desired targets, minimize damage to critical assets, and protect resources from the effects of enemy air and ground attack." (20:13) It is achieved through: hardening; dispersal; camouflage, concealment and deception; nuclear, biological, chemical (NBC), and conventional warfare defense.

Hardening means placing aircraft, ammunition, and critical facilities in shelters, bunkers, and revetments so that only a direct hit or near miss can do serious damage. (14:54) It is used to enhance the survivability of facilities, utilities, critical resources and personnel. Hardening includes: new construction (e.g., hardened aircraft shelters or semi-hardened facilities such as squadron operations buildings), or expedient

hardening (e.g., revetments or earth berming). (30:3) "Efforts to disperse key assets are necessary to force the enemy to attack each target as a separate point target." (20:13) Aircraft, aircraft parking, operational support, critical resources, facilities, and personnel can all be dispersed. Given sufficient warning, resources may be vertically, horizontally, rearward, on-base, or mixed-force dispersed. (14:55-56) In addition, the construction of alternate launch and recovery surfaces, at or near air bases, provides another means of dispersal. (20:13) Camouflage and concealment techniques--to increase the difficulty of locating vital targets--is achieved through the use of camouflage netting, tonedown paints, forestation, smoke obscuration, and night blackouts. Radar and electronic deception devices, and the use of aircraft, equipment or airfield decoys further complicate the enemy's targeting problem. Conventional and NBC warfare defense programs are designed to provide: individual protection (e.g., masks and protective clothing), detection and warning devices, collective protection facilities, and decontamination equipment. (30:3)

RECOVER

The mission of base recovery is to "assess damage, reduce hazards (e.g., unexploded ordnance, NBC contamination, or fire), repair damage to critical resources, and return the air base to maximum combat operational status in minimum time." (20:17) Other aspects of base recovery include: recovery of casualties, medical care and treatment, fire fighting operations, vehicle repair, and the restoration of essential systems for command, control, communications and computers.

Referred to as "Base Recovery After Attack", the concept involves a trained team of disaster preparedness, civil engineering, and explosive ordnance disposal personnel using specialized equipment designed to operate in a post-attack environment. (20:17) It includes: rapid damage assessment, the safing and removing of unexploded ordnance, rapid runway repair (to obtain a minimum operating surface), and the restoration of critical facilities, utilities and communications. (30:4)

GENERATE

The fourth category of ABO programs encompasses those capabilities required for the actual generation, launch and recovery of aircraft in a post-attack environment. Generation programs include: aircraft battle damage repair, flight support, and airfield equipment support. Aircraft ground mobility systems

which allow aircraft to be towed over rough surfaces, mobile aircraft arresting systems, and portable airfield lighting are examples of programs designed to generate sorties. (30:5)

SUPPORT

This final category is the "foundation" of ABO. Support programs include: transportation, host nation support, ABO-related war readiness materiel, personnel augmentation, and the entire air base infrastructure for sustaining people. (30:5) Each ABO program discussed above depends on support. One critical element of support is the commander's system of command, control, communications, and computers; because of its' importance, this system deserves special protection. (20:19)

The USAF has taken the lead both at home and abroad to increase the level of awareness in the importance of ABO, and to take concrete steps toward improving it. The Salty Demo ABO exercise, held at Spangdahlem AB Germany in the Fall of 1985, demonstrated that even a moderate enemy attack could reduce an air base's capability to generate sorties--particularly during the first critical week of hostilities. The task group that studied the results of the exercise came up with 316 recommendations which are currently being addressed by HQ USAF. Furthermore, to study the issue of air base performance, a special panel of the Air Force's Scientific Advisory Board was established in 1986. (14:54) In the future, a USAF/Industry symposium on air base performance--sponsored by the American Institute of Aeronautics and Astronautics--is planned for early 1988. (31:1-2) Finally, the second in a series of ABO capability demonstrations (Salty Demo being the first), has been approved by the USAF Chief of Staff. It is being planned for Bitburg AB Germany, in 1991, and will be called Constant Demo 91. (27:1)

Chapter Six

ANALYSIS OF THE ROLE OF AIR BASE OPERABILITY IN TACTICAL MISSILE DEFENSE

Consider a notional US/NATO air base in Central Europe today. A wing of 72 fighter aircraft (with both a defensive counterair and air-to-ground mission) is assigned to the installation. The base has a runway and a parallel taxiway, each suitable for takeoff and landing. As the result of an international crisis, political tensions are high between East and West. Soviet and Warsaw Pact forces have increased their states of alert and NATO's military authorities are meeting in Brussels in response. Based on the threat described in Chapter Two, how safe is the air base? Could the base withstand a barrage of Soviet tactical ballistic missiles, immediately followed by several waves of fighters/bombers conducting offensive counterair attacks? Could the base repel a covert attack by special operations forces?

The above scenario is intended to illustrate that the modern air base represents a vulnerable, fixed, easily-locatable, time-critical target that could be attacked by an ever-increasing number of weapon systems delivering a wide range of conventional, nuclear, chemical and/or biological munitions. Soviet aircraft and munitions are now more accurate, faster and more effective over far greater ranges. Soviet doctrine has increased its emphasis on conventional air base attack and, consequently, more forces are being fielded with air base attack capabilities. Potential targets on the base could include aircraft in the open or in shelters, personnel, maintenance facilities, fuel, munitions, and operational takeoff and landing surfaces. (28:--)

Moreover, the introduction of a new generation of Soviet short-range tactical ballistic missiles could prove to be a decisive factor in either a pre-emptive or limited-warning attack. Analytical modeling has shown that as few as six to eight tactical missiles with runway cratering submunitions could temporarily close a runway and parallel taxiway. While limited payloads would result in only a temporary closure, tactical missiles could effectively "pin-in" or "pin-out" friendly aircraft long enough to allow follow-on fighters/bombers to inflict serious damage. (32:12) The <u>problem</u>, therefore, is to protect vital US/NATO air bases in Central Europe from the conventionally-armed, short-range, tactical ballistic missile.

FINDINGS

Given the technical considerations, financial drawbacks, and time constraints facing the other tactical missile defense (TMD) alternatives, air base operability (ABO) appears to offer the best, near-term solution to simultaneously counter the aircraft, missile, and ground threats. It is, therefore, necessary to analyze the specific role of ABO by assessing the relative contribution of ABO capabilities/programs to TMD.

The objective of TMD is to protect friendly forces, and critical assets from the tactical missile threat, and to complicate enemy wartime planning. It is comprised of the following four key operational concept elements: passive defense measures, active defense operations, attack operations, and command and control. Because most of the programs/initiatives related to active defense, attack operations, and command and control are long-term (i.e. beyond 1992), this analysis will confine itself to the advantages of "passive defense" measures and, specifically, to ABO as a means to achieve a credible, near-term TMD capability.

The mission of the ABO program is to provide air base commanders with the capability to destroy attacking enemy air and ground forces, to limit damage, and to survive, recover and continue operations under attack. Based on this mission, the ABO program must be designed to counter all ground and air threats--to include the conventionally-armed, short-range, tactical ballistic missile. The five categories of ABO are: defend, survive, recover, generate, and support. Table 2 depicts the major capabilities/programs within each of these five categories, and assesses their relative contribution to TMD. Note that this assessment is subjective--based upon the research required for this paper. A specific analysis of each ABO category follows:

ABO Defense and TMD

The purpose of defense is to destroy enemy aircraft, tactical missiles, and ground threat forces before they can harm the air base. (14:54) By their very nature, defensive systems must be tailored specifically to the threat delivery system. As a result, air defense weapons and air base ground defense forces contribute little to TMD. Point air defense missiles, and gun systems are ineffective against tactical ballistic missiles, and an area defense missile which can counter both the aircraft and tactical missile threats to an air base will not likely be fielded in the near term. Attack warning and assessment systems, on the other hand, could provide a wing commander precious time with which to launch or disperse aircraft, and warn base personnel to seek shelter from an impending missile attack.

ABO CATEGORY	ABO CAPABILITY/PROGRAM	CONTRIBUTION TO TMD POOR	FAIR	GOOD
Defend	Attack Assessment/Warning			X
	Point/Area Air Defense	X		
	Air Base Ground Defense	X		
Survive	Hardening			X
	Dispersal			X
	Alternate Launch & Recovery			X
	Camouflage & Concealment		*	
	Radar/Elect Deception & Decoys		*	
	NBC/Conventional Warfare Defense		X	
	Individual/Collective Protection			X
Recover	Casualty Recovery & Medical Care		X	
	Vehicle Repair		X	
	Restoration of Essential Command, Control & Communications			X
	Base Recovery After Attack			X
	Rapid Runway Repair			X
Generate	Aircraft Battle Damage Repair		X	
	Flight Operations Support			X
Support	Host Nation Support	X		
	War Readiness Materiel		X	
	Personnel & Infrastructure		X	
	System of Command, Control, Communications & Computers			X

* Dependent on terminal guidance system of incoming warhead

Table 2. Relative Contribution of ABO Capabilities to TMD

ABO Survival and TMD

Survival measures reduce the ability of enemy forces to identify targets, minimize damage to critical assets, and protect resources from the effects of attack. (20:13) Hardening, through the use of aircraft shelters, bunkers, revetments, and earth berming is effective against both missile and aircraft attacks. Dispersal of aircraft, and other critical assets reduces the number of targets at the installation. Studies by the Rand Corporation have shown that dispersal is a particularly attractive option when several aimpoints are required to effectively close all of the air base's operating surfaces. Moreover, determining minimum operating surfaces, the number of missiles required, and the number of aimpoints is particularly difficult. For example, although an aircraft such as the F-15E may have a minimum operating distance of 3500 feet for landing, only 900 feet is required for takeoff. Thus, the aircraft could takeoff on far shorter surfaces and still recover at another base or on an emergency landing strip. (32:14-15)

One method of dispersal that is particularly cost-effective is the use of alternate launch and recovery surfaces (ALRS). However, while a second runway/taxiway could provide additional operating surfaces, many bases in Central Europe face severe real estate or political constraints that preclude such construction. An alternative may be to simply pour additional concrete between the existing runway and taxiway to increase the number of missiles required to effectively "close the base." (32:13)

A recent study conducted by HQ USAF/Studies and Analysis concluded that the following measures are among the best ways to lower the probability of a successful tactical ballistic missile attack: increase the number of aimpoints required, or widen existing operating surfaces. To increase the number of aimpoints required, either: reduce the minimum operating surface (by improving aircraft takeoff and landing characteristics or using mobile aircraft arresting systems), add additional ALRS to the air base, or lengthen the existing operating surfaces. (28:--)

The effect of camouflage, concealment, and deception on an incoming warhead is highly dependent on its terminal guidance system. Because the exact locations of NATO's main operating bases are well known, a guidance system similar to that on the US Pershing II could achieve the desired accuracies. Nonetheless, the use of netting, tonedown, forestation, smoke, and blackouts could affect some guidance systems and, moreover, would complicate the follow-on Soviet fighter pilot's targeting problem. Likewise, the use of radar/electronic deception devices in addition to aircraft, equipment, and airfield decoys all add to the difficulty of attacking air bases.

Conventional as well as nuclear, biological and chemical (NBC) warfare defense programs contribute marginally to TMD. Individual protective equipment, survivable collective protection facilities, and decontamination equipment are designed primarily for the NBC threat. To the extent that they could also protect personnel against the conventional threat, then they would indirectly contribute to TMD. Keep in mind, however, that although this research paper focuses on their conventional use, tactical missiles could also be employed with NBC warheads.

ABO Recovery and TMD

Recovery programs are designed to return the air base to its maximum combat operational status in minimum time. To do this, the commander must be able to verify whether or not the tactical missile attack was effective. Integral to the Base Recovery After Attack concept is the capability to quickly assess damage to the runway/taxiway, and to determine the availability and location of minimum operating strips. Helicopters, unmanned aerial vehicles, or other reconnaissance assets organic to the commander's Damage Information and Reporting System could perform this function.

Once damage is assessed, the removal of unexploded ordnance, fire fighting operations, and rapid runway repair (RRR) would commence. Since tactical missiles can carry only limited payloads, it may be possible to repair runway/taxiway craters before the arrival of follow-on aircraft attacks. However, two hours is optimistic for today's best RRR capability and, under wartime conditions, this is likely to be considerably longer. (32:16) Restoration of critical facilities, utilities, and command and control are essential to recovery of the air base. The recovery of casualties and the medical treatment of injured personnel are important functions; however, they contribute little to the commander's immediate need to generate aircraft.

ABO Generation and TMD

Following a TMD attack, the generation, launch and recovery of aircraft must take place. Aircraft ground mobility systems may be necessary to move aircraft over or around debris. Flight support operations must be restored including: airfield equipment support, portable airfield lighting for night operations, and mobile aircraft arresting systems for emergency recovery. Responsive and well-trained aircraft battle damage repair (ABDR) teams would be necessary for the generation of minimally-damaged aircraft; however, ABDR is likely to take several hours/days.

ABO Support and TMD

The capability of an air base to defend against a tactical missile attack, to survive, to recover, and then to generate aircraft, all .ely on its ability to continue to provide essential base operating support functions. Host nation support, and personnel augmentation programs may not be timely enough unless exercised continually in peacetime. Transportation assets and ABO-related war readiness materiel must be immediately available. The air base infrastructure necessary to sustain personnel (e.g., food, clothing, and shelter), must be restored as soon as possible if flight operations are to continue beyond the first few hours of hostilities. Finally, the air base must possess reliable and survivable systems of command, control, communications, and computers.

Prioritization of ABO Programs for TMD

The Air Force Council recently tasked the HQ USAF Deputy Chief of Staff for Plans and Operations to prioritize ABO programs by their greatest contribution to mission, relative to cost. The analysis considered a notional NATO air base with dual-capable aircraft. Rand Corporation analytical, computer models were used with threat and capabilities data projections for 1990. The results of the analysis are directly applicable to a US main operating base in the Central Region. The top priority programs recommended for funding were: damage assessment, explosive ordnance disposal, aircraft/air base enhancement, and alternate launch and recovery surfaces. (34:--) These programs are consistent with those identified in this report requiring special attention for TMD. However, while some programs such as command and control, communications, air defense, and aircraft battle damage repair were not prioritized in the HQ USAF ABO analysis, they would still play an important role in TMD.

CONCLUSIONS

Air power is vital to US national and allied defense strategies. For US/NATO air power to be effective, it must be supported by a relatively large infrastructure--centered on the numerous air bases that support combat air operations. The air base must be regarded as a system, dependent upon all of its subsystems to sustain flight operations. Air bases are critical, high-value, fixed targets vulnerable to Soviet tactical missiles, aircraft, and ground forces. Despite their importance, little attention has been paid to their protection. The temporary paralysis of US/NATO air bases could be decisive in any future conflict. Because of the growing threat to air bases in Central Europe, increased efforts are needed to make them survivable.

The emergence of a new generation of Soviet shorter-range, conventionally-armed, tactical ballistic missiles (i.e., the SS-21, SS-23, and SS12/22) threaten US/NATO air bases in Central Europe. These missiles would be employed at the outset of hostilities to exploit their advantages of speed, surprise, and virtually-assured penetration. They would be integrated into the Soviet Air Operation to achieve widespread, pre-emptive shock effect on unprepared NATO forces. The purpose of tactical missile attacks against air bases would not be to destroy them but, rather, to delay or disrupt US/NATO air operations long enough to allow for the immediate, follow-on penetration of massive waves of Soviet fighters/bombers. Soviet aircraft deliver far bigger payloads and, therefore, represent the greater threat. However, tactical missiles offer considerable leverage by their potential to temporarily cripple US/NATO air defenses.

The best defense against tactical missiles would be to destroy them on the ground before launch through coordinated, pre-emptive attacks. However, political constraints surrounding the defensive nature of the NATO alliance preclude such an option. Consequently, air bases in Central Europe face the reality of having to absorb a "first strike". A politically and strategically more palatable solution might be to use "active defense" measures (e.g., PATRIOT missiles or follow-on missile interceptors) to defend air bases against incoming missiles; that appears, however, to be a long-term, costly, and technologically difficult solution. In the near-term, air base operability (ABO) offers the best, and relatively low-cost means to effectively defend against tactical missiles--while, at the same time, protecting resources from the aircraft and ground forces threats.

The USAF Air Base Operability Program provides air base commanders with the capability to destroy attacking enemy air and ground forces, to limit damage, and to survive, recover, and continue operations under attack. It must be designed to counter all air and ground threats--to include the conventionally-armed, short-range, tactical ballistic missile. Many ABO programs and initiatives can be implemented individually at a comparatively low cost. To effect a near-term TMD capability at US/NATO air bases in Central Europe, priority should be given to ABO programs and initiatives within the categories of "survive" and "recover." Hardening programs (e.g., aircraft shelters, bunkers, and revetments) provide critical blast protection regardless of the delivery system. Dispersal of aircraft, and other critical assets reduces the number of targets at the installation. The construction of alternate launch and recovery surfaces is a cost-effective way to disperse resources and increase operational capability. ABO programs to improve base recovery after attack (e.g., damage assessment and rapid runway repair) need strong support. Finally, measures to protect the system for command, control, communications, and computers are critical to TMD.

RECOMMENDATIONS

The USAF Air Base Operability (ABO) Program significantly impacts upon, and contributes to US/NATO tactical missile defense (TMD) efforts. Recommend that reference to the tactical missile threat be included in Air Force Regulation 360-1, Air Base Operability Planning and Operations, and that the HQ USAF program managers for ABO (AF/XOORB) identify specific, near-term programs/initiatives to counter the threat at US/NATO air bases.

Because of the evolving nature of the threat, and the potential impact of the recent US-Soviet Intermediate-Range Nuclear Forces Treaty on TMD, recommend that the HQ USAF focal point for TMD (AF/XOXXE) obtain a revised threat assessment from US/NATO intelligence communities.

A comprehensive cost-to-benefit analysis is required to compare "active" TMD systems to "passive" defense measures. Recommend that HQ USAF Studies and Analysis (AF/SA) evaluate the operational and financial tradeoffs of each. Based on that analysis, recommend AF/XOXXE develop a USAF "TMD roadmap", and solicit support of the Office of the Secretary of Defense, the Joint Staff, and the other Services. This "roadmap" should complement the TMD Master Plan being developed by the Joint Tactical Missile Defense Special Task Force.

Allied support for US TMD efforts is essential. Recommend that all USAF participants in NATO fora be apprised of TMD developments through a continuing education program sponsored by AF/XOXXE. Briefings, position papers, and TMD-related documents should be disseminated Air Force-wide.

Finally, the importance of air bases to the US/NATO defense strategy cannot be overstated. Survival of these installations is paramount, yet becomes more tenuous as new Soviet threats emerge and evolve. Recommend that USAF program managers, and decision makers assume greater responsibility for the protection of critical USAF resources by advocating, supporting, and funding essential ABO programs.

Postscript

IMPACT OF THE US-SOVIET INTERMEDIATE-RANGE NUCLEAR FORCES (INF) TREATY ON TACTICAL MISSILE DEFENSE

On 8 December 1987, President Ronald Reagan and General Secretary Mikhail Gorbachev signed the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (referred to as the INF Treaty). The purpose of the treaty, as stated in its preamble, is to reduce the risk of nuclear war and to strengthen international peace and security. (19:1) The following paragraphs highlight the key provisions of the treaty and its impact on tactical missile defense planning:

Within the context of the treaty, the term intermediate-range missile includes only ground-launched ballistic/cruise missiles having a range capability in excess of 1,000 kilometers, but not in excess of 5,500 kilometers; shorter-range missiles are those ground-launched ballistic/cruise missiles with a range greater than or equal to 500 kilometers and less than or equal to 1,000 kilometers. Therefore, the treaty covers all ground-launched ballistic and cruise missiles with ranges 500 - 5,500 kilometers. (19:2) Specifically included in the treaty are the following missile systems:

Intermediate-Range: US BGM-109G Cruise and Pershing II; Soviet RSD10(SS-20), R12(SS-4), R14(SS-5), and SSC-X-4.

Shorter-Range: US/German Pershing IA/IB; Soviet OTR22(SS-12) and OTR23(SS-23).

Under the terms of the treaty, each party is to eliminate all intermediate-range missiles, launchers, support structures, and support equipment within 3 years; all shorter-range missiles, launchers, and support equipment within 18 months. (19:3-4) In addition, neither party shall produce, flight-test, or launch any missiles or produce any stages or launchers of such missiles. Parties shall have the right, however, to produce a type of ground-launched ballistic missile not limited by this treaty (i.e., with a range up to 500 kilometers or greater than 5,500 kilometers) which uses a stage similar to but not interchangeable with a stage of an existing missile. (19:5)

Verification by on-site inspection shall be carried out in accordance with Article XI of the treaty as well as the Protocols on Elimination and Inspection. (19:10) In addition, each party shall use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law. (19:14)

Each party shall, in exercising its national sovereignty, have the right to withdraw from the treaty (with six-months notice) if it decides that extraordinary events...have jeopardized its supreme interests. (19:16) The treaty, including the attached Memorandum of Understanding and Protocols, shall be subject to ratification in accordance with the constitutional procedures of each party, and shall enter into force on the date of exchange of instruments of ratification. (19:16)

With the signing of the INF Treaty, many within and outside the US/NATO defense communities are calling for a re-evaluation of the need for an active anti-missile system--comprised of upgraded PATRIOT missiles, specialized sensors and, eventually, exotic (and costly) kinetic and directed energy weapons. One critic believes that, in lieu of addressing the critical military issues related to tactical missile defense, supporters appear to be politically motivated either by the Reagan administration's desire to promote the Strategic Defense Initiative, or the European desire to prevent a "decoupling" of US and European defense. (16:20) In perspective, he believes that Soviet tactical missiles pose so small a threat (compared to aircraft), that large expenditures are not justified. Instead, passive defense measures, such as hardening and dispersal, would be a far more effective way to counter the overall air threat. (16:20) Many in the US and NATO defense communities are likely to agree.

Nonetheless, in a 6 August 1987 memo to the Vice Chairman, Joint Chiefs of Staff, the Joint Requirements Oversight Council (Vice Chief of Staff represents USAF) stated, "We support a <u>high priority</u> for developing a response to the tactical missile threat which poses unique problems for warfighting CINCs....Current arms control negotiations may result in agreements [e.g.,INF Treaty] which will <u>reduce but not eliminate the threat</u>....<u>Full support from each of the involved Services</u>, the Joint Chiefs of Staff, and Office of the Secretary of Defense will be required to define a comprehensive and fiscally responsible program." (24:1-2) The military, therefore, endorses the development of tactical missile defense systems despite any US-Soviet agreements.

Finally, the INF Treaty still requires ratification by the US Congress before entering into force (remember SALT II). If ratified, verification of Soviet compliance will be difficult. Moreover, in time of conflict, the US and its allies cannot afford to be unprepared--agreements become meaningless.

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